3. Pre-OIF C4 Architecture

As you know, you have to go to war with the Army you have, not the Army you want.
—Secretary of Defense Donald Rumsfeld

During a tour of Iraq in 2004, Secretary of Defense Donald Rumsfeld was fielding tough questions about the ongoing War on Terrorism from soldiers at Camp Buehring, Kuwait. In response to a question posed by SPC Thomas Wilson of the 278th Regimental Combat Team, Secretary Rumsfeld's hinted at the battle between legacy systems and the ongoing force transformation undertaken by the United States military. This chapter will establish a baseline of legacy communications systems.

This chapter will examine the Army's C4 communications architecture prior to OIF. The timeframe is March 1995 through January, 2002. Secretary of Defense William Perry's briefing to the United States Senate Arms Services Committee (SASC) in March 1995 marked the inauguration of plans to modernize the current force and recapitalize existing systems. January 2002 marks the start of V Corps' and its subordinate units' planning for possible combat in Southwest Asia.

In January 2003, only two months before the United States attacked into Iraq, a briefing entitled "Fighting Signal in the BCT: C4SIR Architecture" was presented to the Signal Captains Career Course. It stated that the Army's existing switching system was designed to support a bandwidth

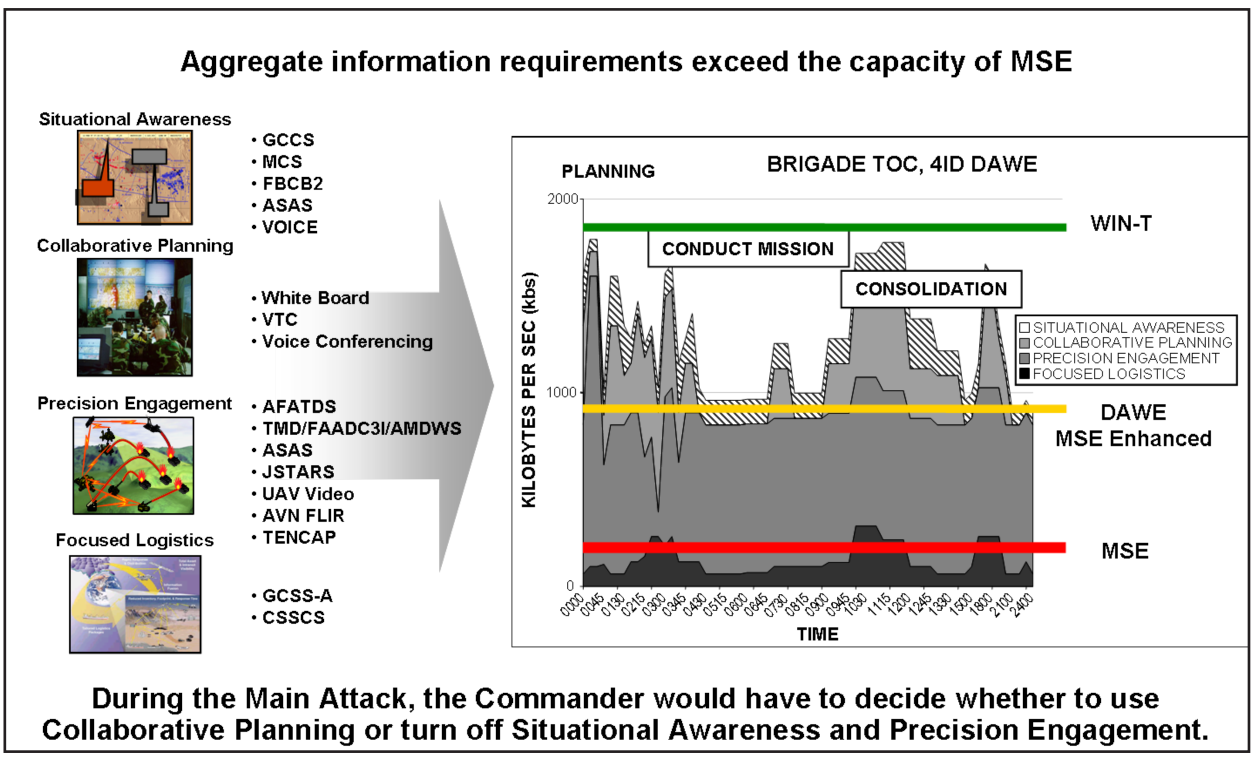

Figure 6. Army Information Requirements.

requirement of 93% voice, 7% data and 0% video. The transmission system, based on terrestrial line-of-site radio vans was limited in the bandwidth that it could support. Its size was based primarily on the voice requirements. It could not, therefore, support the data requirements for combat in future wars such as Iraq. The briefing also pointed out that MSE does not provide the flexibility to "trade-off" between voice and data (see figure 6). In addition, data "pipes" would quickly become saturated, even though voice is under-utilized. As a doctrinal example, the Small Extension Node (SEN) Switch, using the most current upgrade, provides communication services to a division main command post with a maximum data rate of 512 kilobits per second (Kbps). This data rate is split to provide voice, nonsecure internet protocol router network (NIPRNET), and secure internet protocol router network (SIPRNET), along with an automated defense information network (AUTODIN) and a possible video teleconference (VTC) circuit. As a result, the combatant commander must decide whether to use either Collaborative Planning or the Situational Awareness and Precision Engagement tool; he cannot use both simultaneously.[1] This briefing confirmed what many Signal Corps officers already knew or suspected—MSE and even Digital Group Multiplexing (DGM) systems were inadequate for today's modern battlefield and the data expectations of the combatant commanders. As an example of the changes in time, figure 7 shows the growth in data requirements from Operation Desert Storm through operations in Kosovo.[2] This growth in bandwidth requirements continues today.

Over the next ten years, the wording and faces have changed, but the underlying tenets of modernizing the existing force and transforming to a network centric force have not. Secretary Perry articulated his strategy to the SASC:

> *The Department's investment focus must transition to a broad modernization and recapitalization effort. The objective of this effort will be to systematically upgrade and replace portions of the Department's capital stock. It is important to stress that the Department does not need to implement a one-for-one platform replacement of all current inventories. The Department's modernization and recapitalization program will be executed by:*
>
> - *injecting new technologies through service life extension and technological insertions to modernize existing platforms, systems, and supporting infrastructure;*
> - *introducing new systems that substantially upgrade U.S. warfighting capabilities;*
> - *replacing, on a limited basis, older systems on an in-kind basis without seeking to substantially improve or upgrade a given capability.*[3]

From the time of Secretary Perry's briefing, the Army made several major structural moves as it began its transformation. In December 1995, the 4th Infantry Division Mechanized (4 ID) became the Army's first Digitized Division under the Force XXI program. The 4 ID was thoroughly involved in the testing, training, and evaluating of seventy-two major initiatives.

During 1995 and 1996, General William W. Hartzog, Commander, U.S. Army Training and Doctrine Command (TRADOC), brought the serving division and corps commanders together to analyze eleven separate division designs in anticipation of a shift to Army Division XXI. The eleven potential designs were reduced to four. This reduction was primarily based on affordability. The four remaining designs were then modeled and "fought" in simulations in three distinct scenarios, Southwest Asia, Northeast Asia, and Europe.

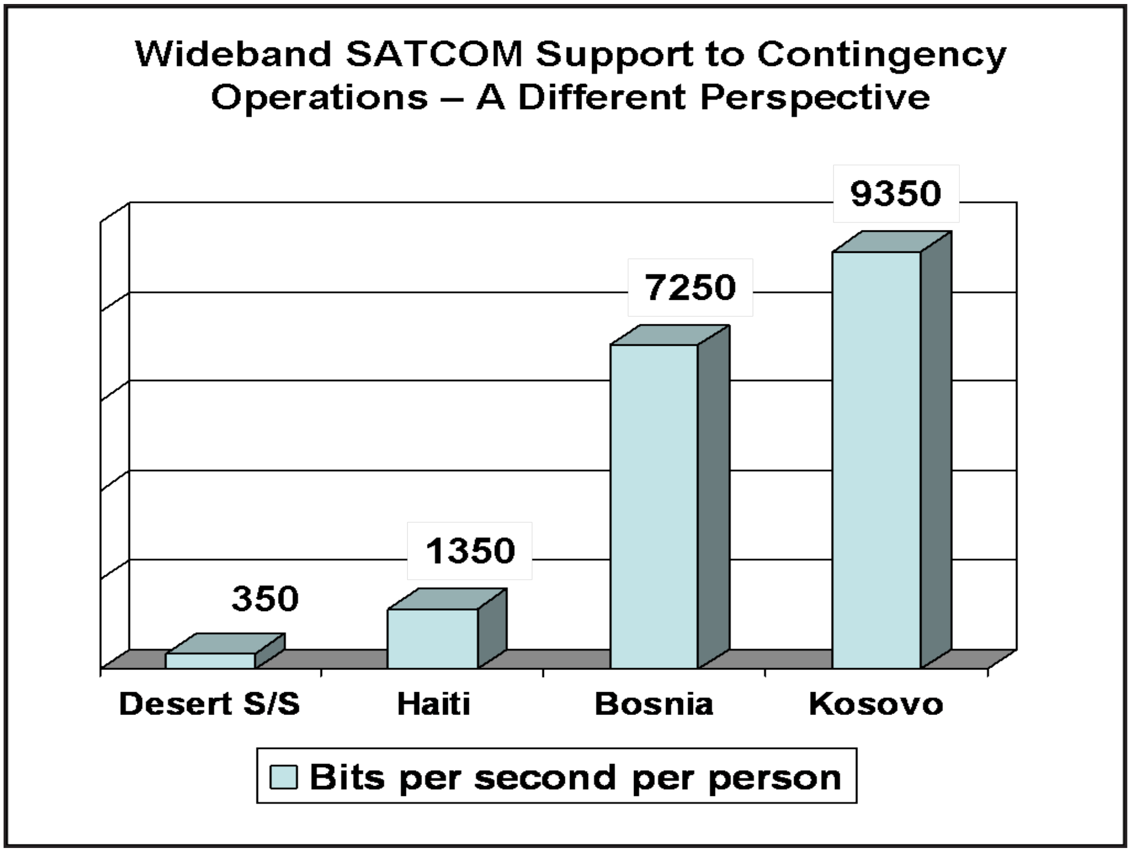

Figure 7. Wideband SATCOM Support to Contingency Operations from Desert Storm to Kosovo

The Army then embarked on a series of Advanced Warfighting Experiments (AWE), culminating with the Task Force AWE held in March 1997 at the National Training Center, Fort Irwin, California, and the Division AWE (DAWE) in November 1997 at Fort Hood, Texas. Following the Task Force AWE, TRADOC considered three variations: the Conservative Heavy Division (CHD), the Strike Division, and the "Brigadist" Division. The CHD was selected based on lethality and affordability, having been thoroughly analyzed during the November DAWE. Based on final analytical data, TRADOC created the Army XXI Division with the assumption that the division was the smallest Army unit that includes elements of all branches and is capable of sustained, independent combat operations.[4]

On October 12, 1999, General Eric Shinseki briefed his plan to transform the United States Army at the Association of the United States Army's (AUSA) annual meeting in Washington D.C. This transformation would create a more responsive, lethal, agile, versatile, survivable, and sustainable force. Without this transformation, the Army would be "stretching yesterday's capabilities to meet tomorrow's requirements [and] would relegate America's sons and daughters, our soldiers, to a tomorrow of increasing uncertainty and risk."[5]

Each of these men spurred the Army's transformation, but the force was still using legacy systems when the United States Army entered Iraq in March 2003. Legacy systems often run on obsolete hardware that requires spare parts that become increasingly difficult and costly to obtain. They are also often difficult to maintain, improve, or expand because there is a general loss of understanding of the system over time. Despite these problems, organizations, to include the Army, can have compelling reasons for keeping a legacy system:

- The costs of redesign may be prohibitive.
- The system requires close to 100% availability, so it cannot easily be replaced.
- The user expects that the system can easily be replaced when necessary.
- The system works well enough that the owner sees no reason for changing it.
- A new system would have a prohibitive operator personal cost in money for training and in lost man hours.

New technologies, when properly injected into an organization's legacy systems, can provide a significant benefit to the unit. The flyaway Tri-Band Satellite Terminal, which was introduced to the Army prior to OIF, is one example. It provided units with a Commercial off the Shelf (COTS) satellite system capable of supporting a variety of missions while fully compatible with the existing ground mobile forces (GMF) satellite terminals. Such new technologies provide a number of significant benefits, including reduced cost, faster procurement, ease of employment, and a smaller size than similar systems developed through the standard acquisition process. The users are insulated from the inefficiencies of their legacy systems while moving towards increased capabilities found in newer technology.

Some of the thorniest problems that units face spring from the effort to leverage or replace existing systems while maintaining combat effectiveness. An example of this occurred during Operation Desert Storm with the 141st Signal Battalion. In 1990, the 141st was under the command of LTC Donald E. Fowler II. They were scheduled to undergo MSE modernization fielding from November 1990 to May 1991. For the months prior to receiving deployment orders for Desert Storm, the unit was focused on turning in the older, Tri-service Tactical Communications System (TRI-TAC) generation of communication equipment. When the deployment announcement for Desert Storm was made, the 141st did not have any equipment in the motor pool with which to deploy. The decision was made to halt the unit's MSE modernization program and to retrieve its older generation TRI-TAC equipment in order to deploy with the 1st Armor Division (1 AD). Once in the Persian Gulf region, the 141st was forced, due to lack of personnel and equipment, to modify signal doctrine and use a radically modified communications network in order to provide support to the 1 AD during Operation Desert Storm.[6]

Following the warfighting experiments in 1997, the Combined Arms Center submitted its Capstone Requirements Document on 30 June 1999, providing "guidance for the development of the Operational Requirements Documents (ORD) for all current and future Army Command, Control and Communications (C3) Systems."[7] The Capstone Requirements Document stressed three key central components that all new systems were to incorporate. These systems were Soldier-System Interface (SSI), which described personnel and common/look/feel requirements; the TOC, which described requirements for integrated, digitized TOCs; and the Capabilities Required Annex. The digitized TOC included an updated version of the Army Battlefield Control System (ABCS), Revision 1b.

Over time, with the addition of "computers" to the mix, C3 became C4. C4 is the integration of doctrine, procedures, organizational structures, personnel, equipment, facilities, communications, and intelligence to support a commander's ability to command and control across the range of military operations. C4 provides commanders with timely and accurate data and systems to plan, monitor, direct, control, and report operations. Efficient C4 is the foundation and the enabler for all other operations. It provides system interoperability, near-real-time collaborative planning, and the shared situational awareness necessary to effectively synchronize combat arms operations.

Organizational Structures

A look into the legacy systems of the Army reveals that they were not able to interoperate at all times. A lack of interoperability was a recurring problem. Sometimes the problems were caused by the unit's position in the new equipment fielding process; sometimes they were caused by the version of system software that the unit had received. These problems are frequently highlighted throughout Volume 1 of this case study, as they illustrated the differences in capability for the haves and have-nots.

Unlike systems interoperability, the TOE is a document that prescribes the wartime mission, capabilities, organizational structure, and mission essential personnel and equipment requirements for military units. It portrays the doctrinal modernization path of a unit over time from the least modernized configuration (base TOE) to the most modernized (objective TOE).

The Base Table of Organization and Equipment (BTOE) is an organization design based on doctrine and equipment currently available. It is the lowest common denominator of modernization and identifies the mission essential wartime requirements for personnel and equipment based on equipment common to all units of a given type organization. In the development of the TOE, the Objective Table of Organization and Equipment, or OTOE, as defined in AR 71-32, is a fully modernized, doctrinally sound organizational design that sets the goal for planning and programming of the Army's force structure and supporting acquisition systems, primarily in the last year of the program objective memorandum and the extended planning annex.

A Modified Table of Organization and Equipment (MTOE) is an authorization document that prescribes the modification of a basic TOE necessary to adapt it to the needs of a specific unit or type of unit.

Each TOE is identified by a unique number that should remain the same throughout the life of the organization. TOE developers, in coordination with the TRADOC force designers, are responsible for developing the proposed TOE number.[8]

As mentioned in Volume 1, preparations for combat in Iraq for V Corps and the 3rd Infantry Division (Mechanized) began well over a year in advance of 20 March 2003, the kick off of the ground war in Iraq. The intensity of training, planning, preparations, mobilizations, and deployments throughout the military, and the improvements in military capabilities during the twelve years since Desert Storm set the conditions for the Operation Iraqi Freedom offensive.

Between 2001 and combat actions in Iraq during 2003, the V Corps Deputy Chief of Staff, COL Thomas A. Kruegler, was tasked to develop the command and control redesign for V Corps, based on the DTLOMS model (figure 8).

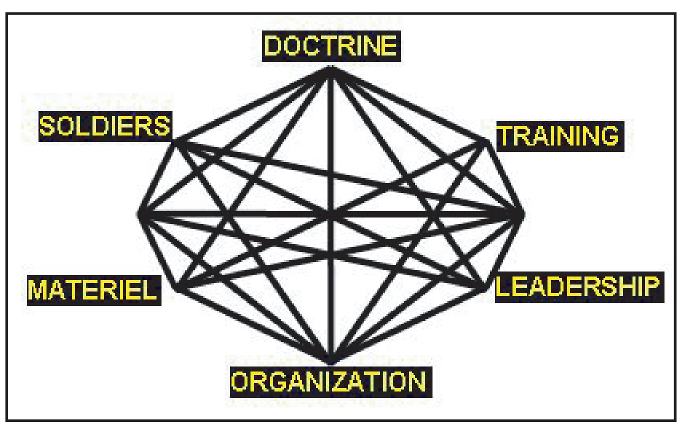

Figure 8. V Corps DTLOMS Model

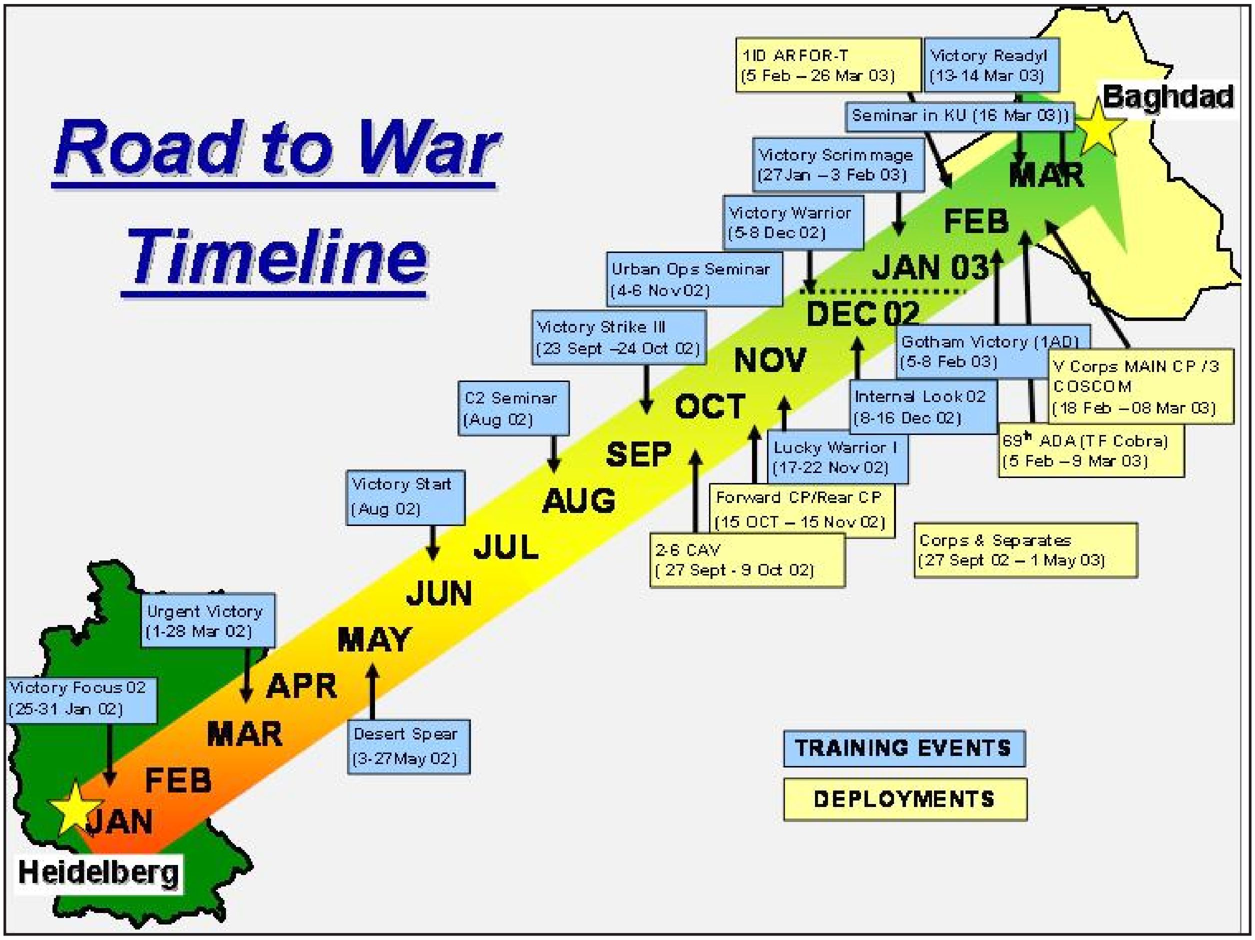

Figure 9. V Corps Road to War Timeline

The V Corps redesign addressed six independent axes: physical plant, battlefield visualization, communications and digitization, common operating picture (COP) and battlefield visualization, home station bed down, and tactical and strategic transportation.

Numerous exercises were designed to test and rehearse deployment plans and reception, staging, onward movement, and integration (RSO&I) procedures. They also included tactical maneuver plans, coordination procedures, and standardized information system displays and requirements. Through exercises, seminars, and rehearsals (as shown in figure 9), V Corps was able to shift its USEUCOM theater focus to the USCENTCOM area of responsibility, where it had not previously operated.

The tasks for V Corps were monumental. Not only did they have to ensure that all subordinate commands (those coming from Germany as well as those coming from CONUS) would be able to communicate with the Corps headquarters, but that they would be operating off of a common version of software within ABCS and within systems not included in the ABCS, such as command and control personal computer (C2PC).

Part of this training and exercising was to ensure that those working with information systems would be fully able to understand and leverage the systems to exploit all available information.

Some systems were not provided until units arrived in Kuwait. This limited the ability to fully train on new systems and hampered the development of tactics, techniques, and procedures (TTPs), which normally would have resulted from training, exercises, and rehearsals.

Out of these and other tests, initiatives were developed into the programs that were used during Operation Iraqi Freedom. These initiatives combined legacy systems, COTS systems, and items being designed for the military from agencies such as DARPA. Other programs that were implemented after the combat phase will be discussed in later chapters of this volume.

Mobile Subscriber Equipment

The legacy communications architecture that V Corps and 3ID took to war during OIF was based on two major systems—MSE and DGM. These systems were developed during the Cold War and did not support an OIF-style battle. During OIF, V Corps and its subordinate units conducted the longest and fastest armored assault in the history of warfare, thrusting from the Kuwaiti border into the center of Baghdad, a straight-line distance of 540 kilometers.

In 1979, the Joint Operational Requirement Board approved the development of the MSE system using the non-developmental item (NDI) acquisition approach. This approach was directed by the Under Secretary of the Army in 1983. The first unit was equipped by 1988, and the last unit completed in 1993.

Since MSE was an NDI program, multiple sources of COTS equipment were utilized in its fielding. This method of acquisition is still in use in the development of several current communications based programs that will be discussed later, such as the JNN and the Deployable Ku Band satellite system known as a DKAT. These programs can, at times, compete with the long-term development of systems funded as programs of record, as both battle for finite pool of funds to develop their products.

MSE has been the communication standard for almost two decades and will continue to be the communication standard until replaced by anticipated programs of record like WIN-T or the COTS-based Joint Network Node (JNN).[9] It has been a consistently reliable program when used in a relatively static location or training environment. In a doctrinal setting, MSE is a common-user, switched communications system of linked switching nodes in Army forces at echelons corps and below. These nodes form a grid that provides the force with an area common-user system, combat net radio, and the Enhanced Position Location Reporting System (EPLRS). This system also allows for the rapid movement of mobile subscriber radiotelephone terminal (MSRT) users if they are within the established grid (see figure 10).

Rules Governing NDI

1. Any item available in the commercial marketplace.
2. Any previously developed item in use by a Federal, State, or local agency of the United States or a foreign government which the United States has a mutual defense cooperation agreement.
3. Any item described in sub-paragraph 1 or 2 above that requires only minor modification to meet requirements of the procuring agency.
4. Any item being produced that does not meet the requirements of subparagraphs 1, 2, or 3 above, solely because the item is not yet in use or is not yet available in the commercial marketplace.

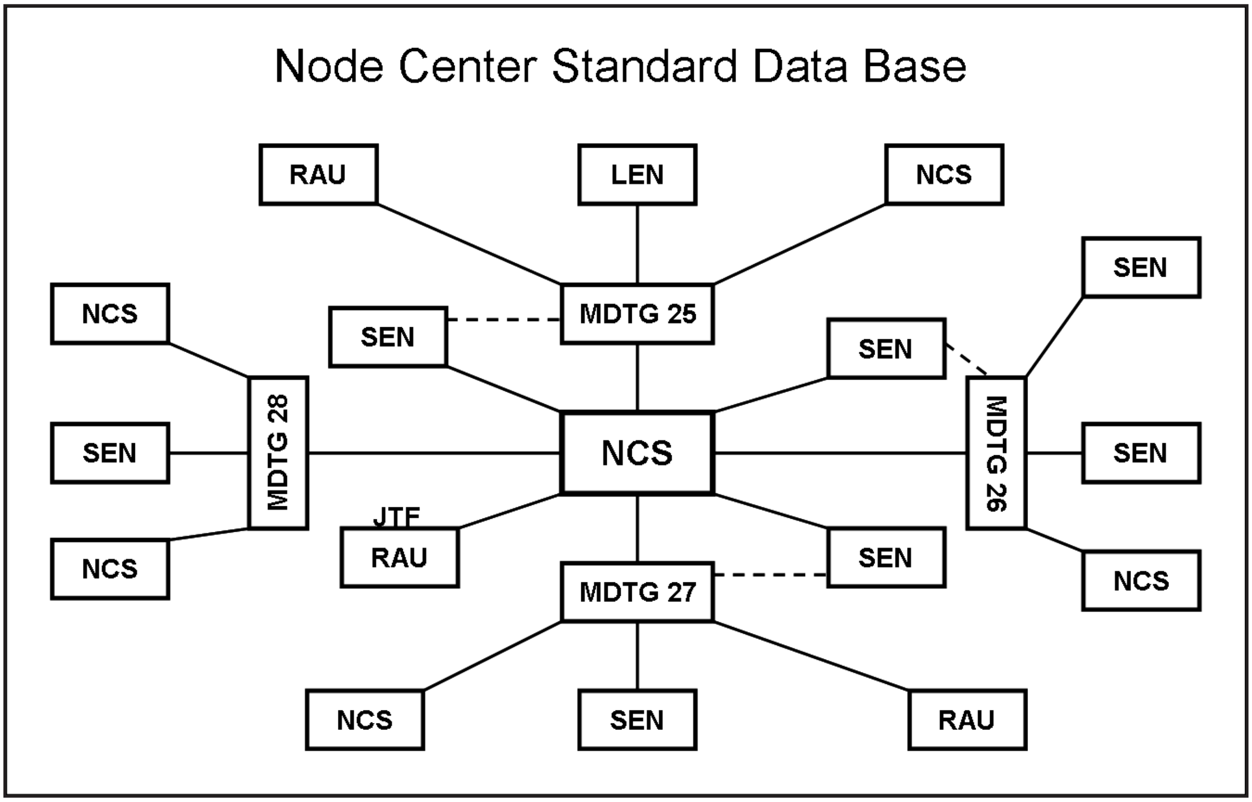

Figure 10. FM 11-43 Node Center Standard Database

As the 3 ID moved towards Baghdad, this grid was never developed. The dispersion of forces, the speed of the maneuver units and threats of weapons of mass destruction did not afford units the time necessary to establish a robust and reliable mesh network. With time and distance being a constant factor in communication support, these units reverted to a series of point-to-point and hub-spoke network designs as depicted in figure 11. These networks increasingly relied on space-based communications links to support the various command centers during the drive to Baghdad. The 123rd Signal Battalion, the signal battalion organic to the 3 ID, was equipped with only two AN/TSC-85 and three AN/TSC-93 satellite systems.

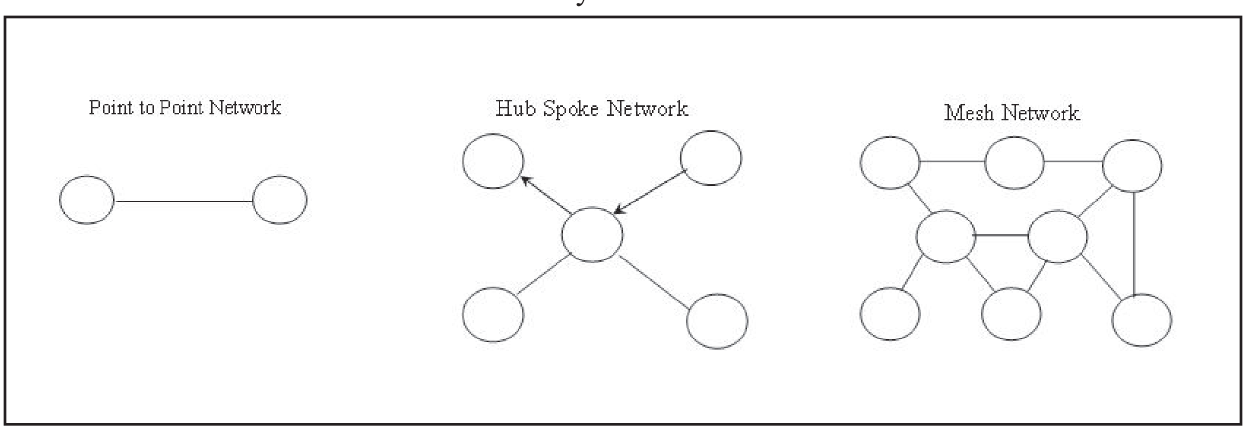

Figure 11. 93rd Signal Brigade TACSOP: Standard Networks

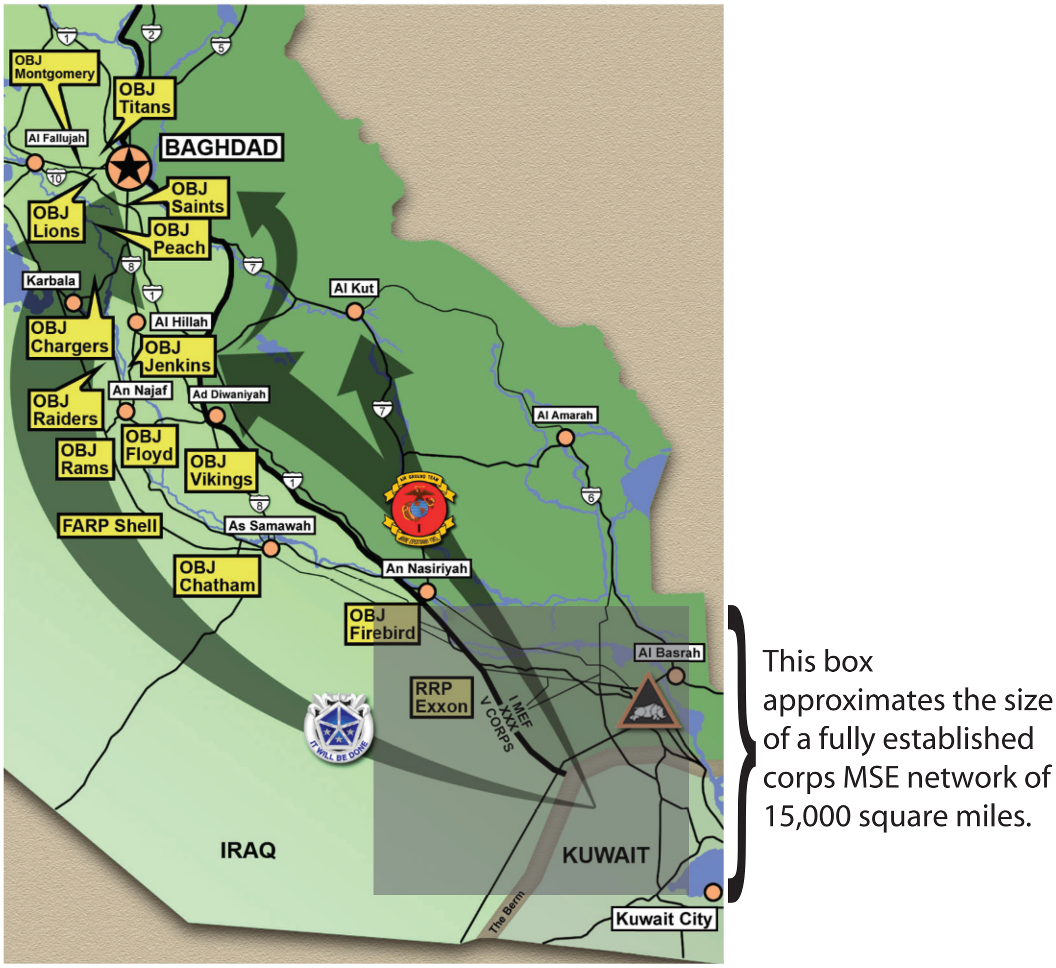

Figure 12. V Corps: Road to Baghdad

MSE was developed to support a corps of five divisions in an area of operations (AO) up to 15,000 square miles, or nearly 24,300 square kilometers. A standard divisional signal battalion is able to field an MSE grid consisting of four to six node centers (NCs) that make up the backbone of the network needed to develop a robust mesh diagram. Throughout the maneuver area, subscribers connect to the small extension nodes/large extension nodes (SENs/LENs) by radio or wire. These extension nodes serve as local call-switching centers and provide access to the network by connecting to the node center switch at the NC. A fully developed MSE network would not be able to support V Corps and 3ID throughout their march to Baghdad (see figure 12). Even without additional assets, the battlefield that faced 3 ID was much too large and, particularly, far too long to be doctrinally supportable. Without additional tactical satellite (TACSAT) assets, the 3ID would barely have been able to establish communications from the Coalition Forces Land Component Command (CFLCC) headquarters at Camp Doha, Kuwait, to the Iraqi City of an-Nasiriyah, far less than half the way to Baghdad.

During OIF, the 22nd Signal Brigade and the 123rd Signal Battalion were the major signal units associated with V Corps and 3 ID. The 22nd Signal Brigade was under the command of COL Jeffrey Smith, while the 123rd was under the command of LTC Joseph Brendler. Their units provided the bulk of communications support to V Corps and 3 ID during the combat phase of OIF.

The standard corps signal brigade is responsible for the installation, operation, and maintenance of the MSE corps communications system. COL Smith and the 22nd Signal Brigade provided area communications support to the corps main, jump, tactical, support commands, and rear command posts. The corps signal brigade is also charged to provide support to major subordinate commands of the corps and to provide a corps special staff for technical communications, automation, and communication security assistance to the corps.

The 22nd Signal Brigade was responsible on a twenty-four-hour basis for the planning, engineering, and controlling of the corps communication system. The standard corps signal brigade is defined in FM-11-30, *MSE Corps/Division Signal Unit Operations,* with the TOE shown in figure 13. It is responsible for the management, technical control, and planning of the MSE Network through the use of the following TOE systems, which are discussed along with the communications capability of a standard TOE corps signal brigade in Annex C:

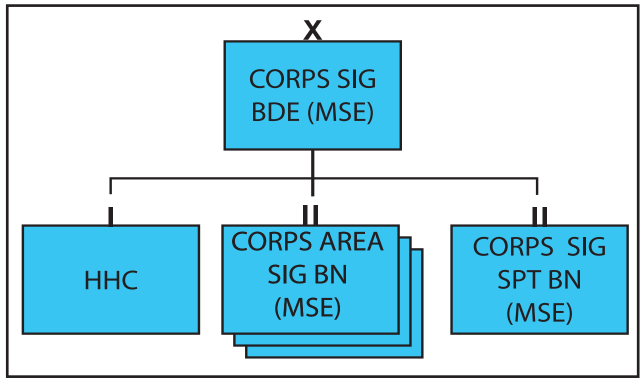

Figure 13. FM 11-30: TOE for a Corps Signal Brigade

- 22 Node Centers
- 4 Large Extension Node Switches
- 144 Small Extension Node Switches
- 47 Radio Access Units to provide access for MSRT subscribers
- 261 Line-Of-Sight (LOS) Radios
- 4 LOS Radios and four wire NATO interface units
- 6 tactical satellite multichannel terminals

The corps signal brigade is also charged with support to major subordinate commands and provides special staff for technical communications, automation, and communication security assistance to the division.

The standard division signal battalion is responsible for the installation, operation and maintenance of the division's MSE communications system. The 123rd Signal Battalion provided area communications support to the division main, jump, tactical, support commands, and rear command posts. The 123rd Signal Battalion was responsible on a twenty-four-hour basis for the planning, engineering, and controlling of the divisional communication system. The standard division signal battalion is defined in FM-11-30, *MSE Corps/Division Signal Unit Operations,* as shown in figure 14.

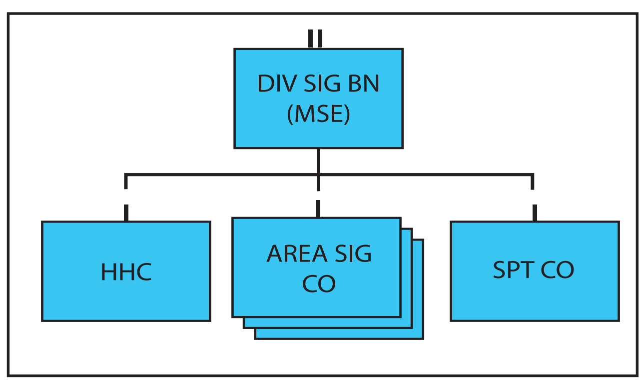

Figure 14. TOE for a Division Signal Battalion

Digital Group Multiplexing—Echelon Above Corps

Digital Group Multiplexing communications systems are found primarily at Echelon Above Corps (EAC) signal brigades. These units are responsible for theater area communications and use a mix of MSE and DGM systems.

The digital systems found in EAC units, as well as the emerging communications programs such as the Army Battle Command Systems, have greatly enhanced the commander's battlefield situational awareness and COP. Digital systems are cheaper, easier to encrypt, have better error correction techniques, and faithfully regenerate digital signals. DGM systems are composed of three major groups: switches, line-of-site radio assemblages, and beyond line of site systems.

During Operation Desert Storm, DGM units used the AN/TTC-39D as their primary switch. By OIF, the AN/TTC-39D (figure 15) had been replaced in most units by the SSS or Single Shelter Switch (AN/TTC-56) (figure 16). Both switches are capable of interfacing with EAC and MSE systems. While the 39D was able to support more links, it requires a 5-Ton vehicle, which makes it much larger and more difficult to transport than the smaller SSS. The SSS is C-130 transportable, while the 39D requires at least a C-17 airframe.

Figure 15. AN/TTC-39D

Figure 16. AN/TTC-56 SSS

The 39D and SSS are fully redundant Common Baseline Circuit Switches (CBCS) that run an active reserve database that monitors every action of the primary database. In the event of a major switch failure, the operator can revert to the active reserve, which will minimize—to the point of transparency—the impact of system failure on direct customer support. This is not an option in the MSE switches, as they are non-redundant.

Army Battle Command Systems

The Army Battle Command Systems, or ABCS, is an integrated family of command and control systems designed for the command and control of battlefield operating systems. ABCS joins together multiple programs responsible for the integration of digital and electronic systems that provide information to the warfighter in the joint environment.

From the Combined Arms Center Capstone Requirement and General Shinseki's transformation briefing afterwards, the ABCS program was integrated into the 4 ID under the Force XXI program in 1995. The 4 ID tested the ABCS from the Brigade AWE in March 1997 through the Division AWE in December 1998. The purpose of the AWEs was to assess the enhancements to warfighting achieved through digitization. Based on the AWEs' initial success, the Army began to fully transform the 4 ID into the first digitized division with the requisite equipment, computer software, doctrine, tactics, techniques, and procedures, training materials, and instruction.

ABCS components are designed to interoperate with the other Department of Defense command and control systems. The ABCS has eight primary components:

- Advanced Field Artillery Tactical Data System (AFATDS)
- Air and Missile Defense Planning and Control System (AMDPCS)
- All Source Analysis System (ASAS)
- Combat Service Support Control System (CSSCS)
- Force XXI Battle Command - Brigade and Below (FBCB2) System
- Global Command and Control System-Army (GCCS-A)
- Maneuver Control System (MCS)
- Tactical Airspace Information System (TAIS)

One of the major enhancements to combat power provided by ABCS is the ability to provide a clear, accurate, and common view of the battlespace. This common view is the common operational picture, or COP. The COP enables the combatant commander to digitally establish and share his combat point of view through a variety of visual products for COP users. It enables a shared situational awareness that significantly improves the ability of commanders at all levels to quickly make decisions, synchronize forces and fires, and increase the operational tempo. The COP consists of shared information on friendly and enemy forces, operational graphics, and other

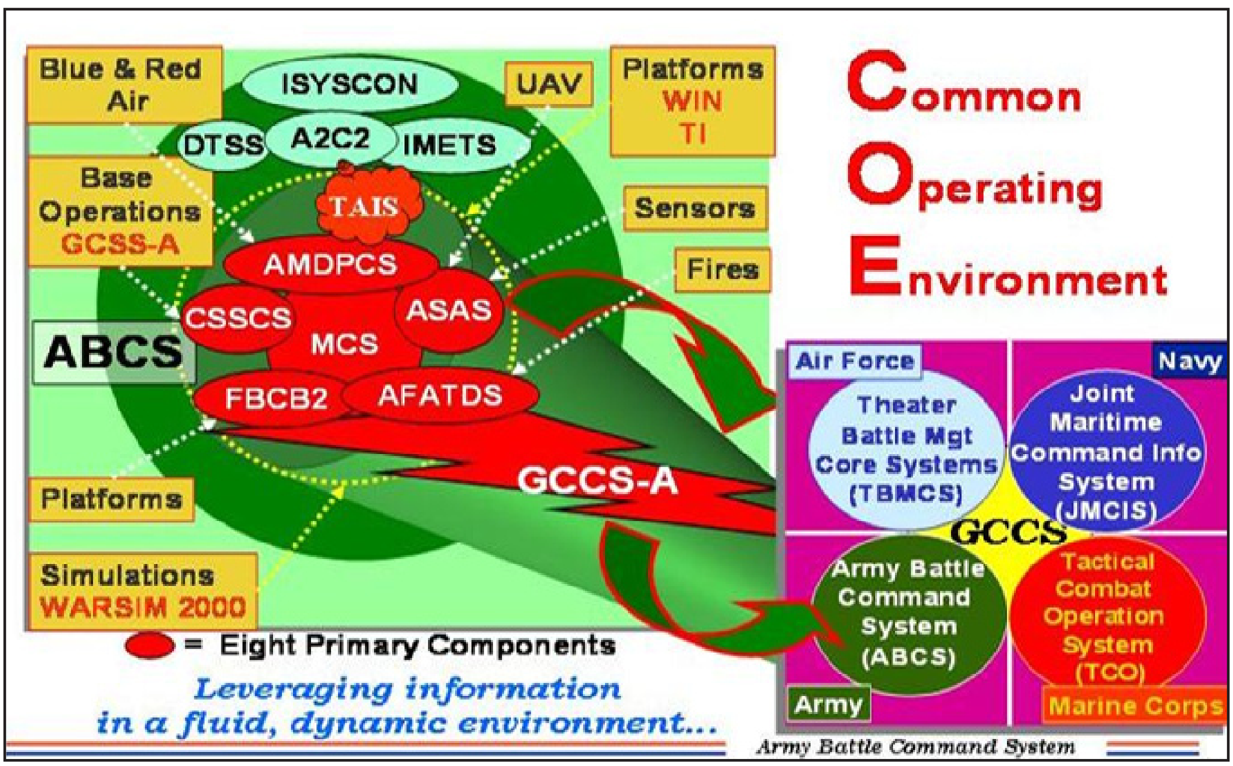

Figure 17. Eight Primary Proposed Army Battle Command Systems

combat-enabling information such as terrain and weather data. The COP lets the commander tailor and filter information and monitor current operations and serves as the basis for planning future operations. The data can then be shared through collaborative tools to meet the requirements of like-equipped units.

The COP application is available on ABCS computers and supporting systems for digitized units. The COP application displays information from a shared database, the Joint Common Database (JCDB). This information can be quickly accessed while displaying on one screen in the command post the critical, time-sensitive information, intelligence, and data drawn from the other Battlefield Functional Areas (BFAs) and from higher and lower systems. The COP is dynamically updated. As data changes in the JCDB, the COP reflects those changes in near-real-time.

The COP template includes the following:

- Notional Overlays
- Friendly unit locations
- Specific vehicle locations
- Graphic control measures
- Other enemy unit locations
- Specific enemy equipment, facilities and individuals
- Logistical information
- Adjacent and higher units
- Unmanned aerial vehicle (UAV) activity
- Cruise missile speed and direction of flight
- Current weather conditions, weather forecasts, and severe weather warnings
- Mobility, trafficability and line of sight decision aids

Prudens Futuri